INTERNATIONAL RICE COMMISSION

NEWS LETTER

Issued by the I.R.C. Secretariat c/o FAO Regional Office, Bangkok, Thailand.

No. 4 *December 1952.*

RICE IMPROVEMENT IN THE UNITED STATES*

C. Roy Adair

THE Division of Cereal Crops and Diseases of the Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture conducts rice improvement investigations in cooperation with the state agricultral experiment stations in Arkansas, California, Louisiana, and Texas. This work is carried on at the Rice Branch Experiment Station, Stuttgart, Arkansas; Biggs Rice Field Station, Biggs, California; Rice Experiment Station, Crowley, Louisiana, and the Rice-Pasture Experiment Station, Beaumont, Texas.

The rice varieties developed as a result of these cooperative investigations are widely grown in the United States. In 1951 over 99 per cent of the rice acreage in the United States was planted to varieties developed as a result of this work.

The objectives of the rice breeding work now underway are to develop early, midseason, and late-midseason varieties of short–, medium–, and long-grain types that are resistant to all important diseases, have a wide rang of adaptation, are suitable for harvesting by the combine-drier method, and which produce high field and mill yields of rice of the desired cooking quality.

Work is being carried on to develop varieties for special conditions. One example is the work in Texas to develop varieties tolerant to saline conditions of

* *Contribution from the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Adminstration, United States Department of Agriculture for the IRC "News Letter."*

the Gulf coast. Other examples of these special problems are the work in Arkansas to develop varieties that are high in protein content and in California to develop hardy, long-grain varieties that are suitable for growing in that State.

Increase of the seed of the new improved varieties of rice and the distribution of that seed to growers of certified seed rice, is being done at each of the rice stations. This program has been successful not only in getting the farmers to grow these improved varieties which has resulted in increased production, but it also has been a factor in improving the grade of the rough rice produced.

Fundamental studies on the genetics of rice are being conducted as an aid in the breeding program. This work is centered largely in Louisiana, although some genetic work is done from time to time at the other cooperating stations. Some work is being done on morphology so the rice varieties can be classified on the basis of plant characteristics and growth type. It is planned to conduct fundamental investigations on the cytology and physiology of the rice plant as time and facilities permit.

This paper gives only a general outline of the work being done on rice improvement in the United States. A more detailed account of each phase of this work will be given in later editions of the "News Letter."

NOTES ON THE EXPERIMENTAL WORK IN PROGRESS ON RICE IN TRINIDAD

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The following projects are being carried out at the Central Experimental Station of the Department of Agriculture, Trinidad :—

1. Manurial trials lo investigate the effect of various combinations of N. P. K. lime and green manure.

Up to the present time manurial trials in Trinidad have shown a response only to the application of Nitrogen. In most areas the application of fertilizers would be uneconomic, due to the high cost of the fertilizer and the relatively low responses recorded even with the placement of the fertilizer. A trial at present in progress is expected to give some information on the combined responses of fertilizers, and green manures.

2. Manurial trials at the nursery stage.

It is believed that the considerable improvement in yield can be achieved by better nursery practice and early planting. Reduced costs could also result due to the reduction of supplying and replanting.

3. Physiological studies into the nutritional requirements of rice, and the production and description of deficiency symptoms.

4. The efficient control of weeds by hormone type weedkillers.

5. The production of pure-line stocks which will form the basis for the seed multiplication scheme and further work on breeding and selection.

6. The part that machinery can play in the improvement of local rice cultivation and the improvement of cultivation practices generally.

September, 1952

THE RICE INDUSTRY IN TRINIDAD

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Rice, the staple food of half the world's population, is the most popular and most essential vegetable in Trinidad and Tobago. Without it, the people would suffer.

Since the last war rice has been in short supply. We do not grow sufficient for the needs of a rising population. We cannot import sufficient from the neighbouring Colony of British Guiana, which is now our only source of supply. Because of its high price, Government has been obliged to subsidise this imported rice, and there is every indication that the existing price will rise considerably in the near future. Indeed, it is very clear that the time has arrived when this Colony should take steps to increase its production of rice with the ultimate goal of self–sufficiency.

Government, very wisely, appointed an ad hoc Rice Committee to consider the situation. As the result of this Committee's findings it was decided that in future, a strong progressive policy would be adopted towards rice production. A Standing Rice Committee was appointed to guide the future of the industry, and funds were set aside for the development of certain areas for rice under a Five Year Economic Programme. The work of expanding our rice production is, therefore, about to start.

It would be well to examine the local rice industry as it now stands.

Padi is grown chiefly by the East Indian farmer and primarily for his home consumption. Whatever surplus exists over and above domestic requirements is sold at the highest price obtainable.

The main crop is grown during the wet season of the year, between the months of June and December. A very small and negligible ratoon crop is obtained early in the year.

The bulk of the crop grown is swamp padi which comes from low – lying lagoons. Such areas must be flooded dur-

ing the growing season about 4–6 inches of water in order that good crops may be obtained.

A small amount of hill padi is grown upon higher lands, usually in mixed cultivation with other crops. The yield of such padi is low.

No padi is grown in Tobago.

Now it is to the credit of the persistent farmer that some 18,000 acres of swamp padi land are cultivated in Trinidad. These areas, for the most part, suffer from defective drainage, through the absence of channels or by blocked waterways. Flooding frequently occurs, resulting in crop losses.

Padi fields are usually laid out in small lots, with no adequate plans for good water control, and they are bunded to suit arbitrary divisions or levels of the land. The result is that our padi fields resemble the pattern of a crazy pavement. The lack of efficient water control impairs cultivation and causes frequent friction between neighbouring farmers.

Holdings tend to be fragmented, so that one farmer may cultivate padi in several different places.

The roads and traces in many swamp padi areas are defective, and such transportation difficulties adversely affect production.

Cultivation methods are primitive; for the small size of our fields and the lack of proper water control make mechanisation difficult. Some areas are never ploughed. The operations of planting, weeding, harvesting, threshing, winnowing and drying are all performed by hand labour.

Though some farmers grow recognised types of local padi no adequate provisions have yet been made for the production and distribution of high yielding and suitable types of tested pure line seed.

Numerous small mills are scattered throughout the countryside. A unit usually consists of an enclosed shed, containing a small diesel engine attached to a huller. The outfit mills raw padi in one operation to produce white rice. The more nutritious parboiled rice—the type imported from British Guiana—is only produced when the parboiling operation is done in a very smaller way by the individual farmers.

Such then is a brief description of the present rice industry. Some of the measures by which this industry may be expanded and improved may now be considered.

At the onset it will be necessary to perform a preliminary survey of the industry, followed by another and more detailed investigation. Such information will indicate specifically where improvements are desired and serve as a standard by which to gauge furtue progress.

It has been estimated that in order to eliminate importation and achieve self-sufficiency in rice, Trinidad will have to increase its padi lands from about 20,000 to 50,000 acres.

Increases of acreage can be obtained

by opening new areas and making them suitable for the growing of padi.

The improvement of water conditions in existing padi areas will also add materially to production; for when improvements are made and maintained, losses by floods will be minimised or eliminated. Moreover, one may expect that more padi land will be taken into cultivation within or adjoining an improved area. Controlled drainage is the thing that is most needed in the padi fields of Trinidad.

The work of expanding and improving padi lands is about to start in those schemes outlined in the Five Year Economic Programme.

It is strongly recommended that new padi lands should be laid out not in small irregularly shaped portions, but in large, long, level fields, bunded along the contours of the land. Each field should be capable of being drained or irrigated independently. Access by roads or traces should be adequate. All improvements when once they have been made should be properly maintained. Land of this nature may be brought into being with the help of heavy modern machinery such as excavators, bull dozers, dikers, graders, tractors. The lay-out provides for efficient water control and allows the use of machinery for the cultivation of padi.

One can visualise such fields being ploughed, harvested or levelled with tractor drawn implements, and seeded mechanically at the beginning of the rains with tractor drawn seed drills. Weeds would be kept down during the growing season by maintaining a constant water level in the fields and possibly by the use of a chemical weed killer such as 2, 4-D, which may be applied in the form of a spray. It is unlikely that the heavy combined reaper and thresher will be used for harvesting, for the season that the main reaping season occurs at the end of the year, when the rainfall is appreciably high. The mechanical threshing of padi with small portable threshers is, however, most feasible.

Of course local economic conditions of a zone may not make it possible to introduce elaborate machinery in every instance but labour saving devices need not be elaborate. Eor example, animal drawn ploughs could be introduced into a zone where ploughs and animals are scarce, and where ploughing would increase yields. The great points about machines are that they should suit local conditions, help to save human labour, and if possible decrease the cost of production.

Much can be done for farmers by the creation of an advisory staff specially trained to teach improved methods of rice production. Such a staff is about to be brought into being.

The field staff will, from the start, tell farmers that it would be a good thing to grow pure line padi; for by the use of high yielding strains it is possible to increase yields per acre by about 200 lbs. Indeed pure line padi is perhaps the cheapest method of increasing production. Desirable types of pure line padies such as D110, D52/37 and D79 have been

tested and found to give high yields. The formation of a permanent padi multiplication and seed distribution scheme is, therefore indicated. These types of padi, or perhaps others, could be multiplied on one or more blocks of land, and the crops distributed to farmers in proprotion to their needs and on a basis of exchange—seed padi being given in exchange for ordinary padi.

More can be done to assist the industry. For example, the small primitive mills which have been described, may in time become obsolete, and they may have to be replaced by larger and more modern units. One cannot, of course, at this stage, forecast the ultimate trend of progress.

One thing is, however, certain. It is not by Government's help alone that the production of rice will be increased to its maximum. The cooperation and assistance of our farmers are also required, together with the will of all concerned to work hard in order to achieve the much desired goal of self—sufficiency in rice.

March, 1951

REPORT OF THE ACCOMPLISHMENT OF FARM MECHANIZATION IN THE PHILIPPINES[1]

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Right after liberation in 1945 the Philippines was desperately in need of food, particularly of the staple food, rice. The problem was aggravated by the fact that 47% of the work animals was lost during the liberation. Many of the rice fields were abandoned and have grown thick with "cogon" and "talahib." Efforts were made to import work animals from other southeastern countries but this attempt failed. The only answer was mechanization.

Fortunately hostilities with Japan terminated and surplus tractors in the army depots were released to the Philippines Government. With this as nucleus the Agricultural Machinery and Equipment Corporation (AMEC) was established which later became a Department of the National Development Company (NDC). There were plenty of tractors but not enough plows and harrows. The AMEC went into the manufacture of farm implements using spare parts from the surplus and scrap iron. There was a dearth of mechanics. AMEC established a school

1. *This will be followed by a report on mechanization of different sized farms under different methods of farming.*
2. *Member of the Philippine National FAO Committee*

for mechanics in connection with its shop repairing the tractors.

The AMEC also established farm machinery pools in different parts of the country for the purpose of helping small farmers who could not afford to buy mechanized equipment.

The work of the tractor pools was mostly on clearing lands and first plowing and first harrowing of rice fields. This method has helped a great deal in the production, because the work animals were lacking in number and the tractors were able to take the place of the carabaos that would be needed for this work. Experience has shown that when tractors do the first plowing and first harrowing, the carabaos can cover twice the area that it would be able to work if it were used alone. It is estimated that an average carabao can cultivate three hectares and, using this as basis, computations were made in the number of carabaos, the work of which can be taken over by tractors as shown in Table 1 (omitted here), which gives the equivalent number of carabaos relieved by tractors to do increased work and the amount of additional palay produced.

The United Nations Relief and Rehabilitation (UNRRA) through the Philippine Relief and Trade Rehabilitation Administtration (PRATRA) has also distributed farm implements. The National Land Settlement Administration (NLSA) established tractor pools in its settlements. Besides the old machinery dealers, new ones were established which imported equipment for sale. The country became mechanized—farm conscious.

In 1947 the Rice and Corn Production Project was organized under the National Development Company for the purpose of starting mechanized farming. This was subsequently converted into the Rice and Corn Production Administratton (RCPA) which went into the clearing of large tracts of virgin lands for the production of food crops, particularly rice and corn, by mechanized method. It opened up new areas in the Ala Valley in Cotabato, Maramag in Bukidnon, and Panakan in Palawan. It imported modern machinery costing about P* 3,000,000. It has constructed roads through the wilderness, controlled malaria and built modern communities in the hinterlands. It established modern warehousing, including the drying of palay, corn and other farm crops.

During the existence of the RCPA, it has cleared 10,867 hectares and had planted by administration 8,235 hectares, producing 188,707 cavans of rice excluding corn, mongo and other crops. The rest of the area had been distributed to settlers. The RCPA was instrumental in popularizing mechanized farming by giving demonstrations on mechanized farming methods. It has established model farms of different sizes, making separate accounting of each one to serve as guides for the farmers owning different sizes of farms. It has worked out various systems of farming and various systems of crop rotation. The RCPA farms became the demonstration grounds for mechanized farming. It is visited daily by hundreds of farmers. It is the practice of every farmer who intends to go into farm

* *Note : P = pesos.*

mechanization to visit these farms before embarking on his project.

Another new system started by the RCPA is the soil conservation practices. The RCPA farms in Bukidnon are on rolling lands. It has evolved a system of soil conservation and adopted the practice of contour farming according to modern standards. This very successful experience blazed the trail for the farmers of the rolling lands of Cebu, Bohol, Batangas and the Ilocos provinces which are fast being depleted due to erosion. It has proven the use of mechanized methods to make this type of farming pay.

The RCPA had to train farm machinery operators which are so sadly lacking in this country where mechanization is just in its infancy. Farmers adopting the mechanized methods got their operators from the RCPA. The shop personnel of the RCPA took pride in their shop as an excellent training ground for the farm machinery operators and first class mechanics. Many who have adopted the mechanization may have failed, beause of inadequate maintenance of equipment.

Rice harvesting is the main problem in sparsely populated areas because it needs five men to harvest what one can plant. For this reason the RCPA established Farm Machinery Pools and used combines to harvest the rice crop of neighboring farms.

Another problem of big scale upland rice farming is the drying upland palay because it is harvested during the rainy season. This was solved by the RCPA in the erection of artificial driers. It was found that artificially dried palay has higher milling recovery and better quality of rice than that dried by the sun.

Incidentally warehouses had to be established in connection with these driers which improved storage not only on savings due to pests but also to higher milling recovery and better quality of rice.

In October 1950, the National Land Settlement Administration (NLSA), the RCPA, and MED were merged togther to form the Land Settlement and Development Corporation (LASEDECO) for the purpose of synchronizing all of the land development work into one office. This new office continued the work of its predecessors but this time it gave more emphasis to the distribution of land to the landless. The LASEDECO has cleared areas and distributed them to the new settlers after the crops suited to the place and the type of farming have first been determined. It builds roads, irrigation systems, establishes malaria control units, etc. before the immigrants are given the lands. This had given impetus to the immigration of the population from the thickly populated areas to this LASEDECO farms to such an extent that it is now impossible for the LASEDECO to accommodate all who apply. What makes it worse is that many people, instead of applying first and waiting for the signal to go to the settlement, go directly and demand their share of the land. This practice has brought confusion which I hope would be alliviated by the impending financial aid under the United States

Mutual Security Agency (MSA). There is also a bill now in Congress to appropriate P* 10,000,000 for this purpose. The LASEDECO now has the experience, the man and the equipment necessary to continue clearing land, building roads and irrigation systems, and to control malaria and undertake other necessities for the establishment of new communities in the wilderness.

Experience in the Philippines has shown:

1. It has been proven beyond any reasonable doubt that mechanization in the clearing of new areas and the establishment of new communities is indispensible to make the life of new settlers tolerable if not comfortable.

2. That upland rice can only be produced at a profit by means of mechanization.

3. That lowland rice culture can be fully mechanized contrary to previous assumption.

4. Corn culture is the easiest to be mechanized.

5. That the only economical and quick way of clearing land is by mechanization.

6. That there are now enough operators and technical men to handle farm mechanization on big scale in the Philippines; and that the Filipino is adept to adoption of machinery in their methods of production.

7. That by the use of extension rims, rubber tire tractors can be used successfully to plow rice fields with 4 to 6 inches of water. This was proven in the Bureau of Plant Industry trials.

8. That by means of mechanization, work on the farms can be planned on a year round basis, thus providing work for the farmers throughout the year giving them that much for income and controlling weeds.

9. That irrigation by pumping is favorable and can economically be practised in many Philippines farms both for the regular rice crop and the palagad.

In the accompanying tables (omitted here) are shown the accomplishments in rice production due to farm mechanization and the clearing with the use of machinery; comparative labor record and cost of production per hectare of lowland and upland rice in the Philippines; comparative labor record and cost of production of wet season corn in the Philippines; and cost of mechanized clearing per hectare.

It is shown in Table 1 that for a period of five years (1947—1952) a total of 1,141,720 hectares were plowed (1st plowing) and harrowed (1st harrowing) by means of tractors, the rest of the operations being accomplished with the use of carabaos; 283,365 carabaos were displaced by tractors and as a result of which an additional 850,095 hectares were planted to rice. During this period a total of 23,141,272 cavans of palay have been harvested.

Table 2 shows that during the same period, 1947—1952, 455,000 hectares had been cleared and planted to rice with the use of 2,275 tractors sold by the AMEC

* *Note : P = pesos.*

to private farmers. The total production of the said area amounted to 12,285,000 cavans of palay. The clearing, planting and other farm operations were undertaken by the private farmers.

Likewise the tractor pools operated by AMEC, NISA, LASEDECO, and RCPA were able to clear and plant to rice an area of 86,250 hectares with the use of 432 tractors. Approximately 2,328,750 cavans of palay were harvested from the said area. The operations were also undertaken for the private farmers.

As will be noticed in the table, a grand total of 2,707 tractors were employed in clearing and planting an area of 541,250 hectares which gave a harvest of 14,613,750 cavans of palay.

Adding the above harvest of 14,613,750 cavans to the grand total of 23,141,272 cavans in Table 1, the rice production during the period of 5 years by means of mechanized farming amounted to 37,755,022 cavans of palay.

In Table 3 is shown the comparative record and cost of production per hectare of lowland rice in the Philippines. The semi-mechanized farming under column 4 of the table is meant that the first plowing and first harrowing were done by means of tractors and other farm operations were undertaken with the use of work animals. The summary given in the table indicates that in lowland rice mechanized farming, the cost of production per hectare is P* 247.96; semi-mechanized farming, P* 395.00; and carabao farming, P* 470.85. The average yield per hectare in mechanized farming is 55.5 cavans of palay; semi-mechanized, 61.2 cavans; and carabao farming is 60.1 cavans; and the cost of the production per cavan in mechanized farming is P* 4.47, semi-mechanized P* 6.45, and carabao P* 7.83.

It can be readily seen that even though the average yield per hectare with the use of carabao is higher than that of mechanized farming, the cost of production per cavan with the use of work animals is very much higher than that of mechanized farming. It is also higher than that of semi-mechanized farming.

Table 4 shows comparative labor record and cost of production per hectare of upland rice in the Philippines. It will be noted that in mechanized culture the cost per hectare is P* 204.16; semi-mechanized farming, P* 351.31; and carabao farming, P* 368.83. The yield per hectare in mechanized culture is 34.3 cavans; semi-mechanized farming, 33.4 cavans; and carabao farming, 31.5 cavans. Based on this yield per hectare, it has been estimated that the cost of production per cavan in mechanized farming is P* 5.95; semi-mechanized, P* 10.53; and carabao farming, P* 11.70.

Like in the culture of lowland rice the cost per hectare as well as the cost of production per cavan in carabao farming is considerably higher than that of mechanized and semi-mechanized farming.

Table 5 shows comparative labor record and cost of production of wet season corn in the Philippines. As will be noted in the table the cost of production per hectare in mechanized culture is P* 183.06, semi-mechanized farming P*259.68, and carabao farming P*264.50.

* *Note : P = pesos.*

The average yield per hectare is as follows: In mechanized culture 27.4 cavans; semi-mechanized farming 25.5 cavans; and carabao farming 19.3 cavans. The cost of production per cavan in mechanized culture is P* 6.68; semi-mechanized farming, P* 10.18; and carabao farming, P* 13.70. Here also the cost of production per hectare with the use of work animal is much higher than that of either mechanized or semi-mechanized farming.

Table 6 shows the cost of clearing "cogonals" in the RCPA projects in Cotabato and Bukidnon provinces in Mindanao with the use of machinery. The successive operations are as follows: (1) rolling the "cogon" or "talahib"; (2) pulling down trees including towing to the edge of the field; (3) piling and burning the twigs and gathering and piling of stones and rocks; (4) first plowing; (5) first harrowing and finally (6) contouring.

The cost of mechanized clearing per hectare of land involving wage of labor, depreciation, maintenance, repairs and interest on capital investment came out to be P* 102.34 in Ala Valley, Cotabato, and P* 93.27 in Maramag, Bukidnon. The slight discrepancy in cost can be explained by the fact that there were more trees to be pulled down in the grassland of Cotabato than that of Bukidnon.

Acknowledgements

The writer is very grateful for the assistance given by Mr. Enrique Lazaro, Cost Accountant, LASEDECO, in the examination of voluminous records, analysis of data and computation of figures indicated in the tables. He likewise wishes to express his appreciations to Dr. Manual D. Sumulong, Executive Secretary of the Philippines National FAO Committee, for editing the manuscript and making the summary of the different tables, and to Dr. Santiago R. Cruz, Senior Agricultural Engineer, DANR, for valuable suggestions.

SOME GENERAL CONSIDERATIONS ON THE MECHANIZATION OF RICE CULTIVATION IN THE FRENCH OVERSEAS TERRITORIES

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There are two ways of looking at the question of mechanization:

1. complete mechanization, as in the United States, for example; and
2. partial mechanization, restricted to certain operations with which the cultivator can profitably be helped.

* *Note : P = pesos.*

1. Complete Mechanization

Two mechanized rice cultivation projects have been started in French West Africa (in Senegal and the Soudan), covering about 4 000 hectares in 1951/52. Others have been started in the Lake Alaotra area of Madgascar. The purpose of these projects is to achieve a rapid increase of rice production in spite of the lack of labour.

It must be admitted that, in general, the results obtained up to now in this respect are not entirely satisfactory and this is mainly due to the difficulty of mechanized harvesting (self-propelled combine).

Although the problems raised by preparation of the soil, sowing and the control of weeds by letting the rice germinate in water have been solved satisfactorily, this is not so for the problem of harvesting. The real difficulty is not in the operation of the machines; it lies in ensuring correct condition for the right moment as far as muturity is concerned.

It is a question of having varieties that are resistant to lodging, ensuring complete water control and drainage and planting a range of varieties with different maturation periods so that the harvest can be spread over a sufficiently long period of time.

All these questions raise very complex problems. The complete mechanization of ric cultivation is as complicated and as difficult to perfect as the mechanism of a watch.

2. Partial Mechanization

In Madagascar, French Guinea and the French Soudan, there have been for many years mechanized cultivation units which rent out their machines and services to the rice cultivators for the preparation of the soil. The tractor has the advantage of being usable over a long period, while the animal-drawn plough can only be used during the few weeks when the soil is at the right degree of moistness. Another advantage is that, thanks to the deep ploughing in the dry season—which can only be done by tractors—the reproduction cycle of the weeds, particularly the wild rice (Oryza perennis Moench), can be interrupted. Powerful machines (at least 60 h.p. and with caterpillar tracks) are needed for this work.

The use of these machines was enthusiastically received by the people but the great difficulty is to establish a practical formula for the use of the machines, which require, for satisfactory utilization, that the crops be sufficiently concentrated and that the cultivators using the machines accept a cooperative cultivation programme.

It is still too early to pronounce a final judgement on the possibilities of partial mechanization. Technical success has been achieved. Financial success remains to be demonstrated. It is interesting in any case to point out that this system has the advantage of enabling the cultivators to extend their cultivated areas considerably without upsetting the traditional methods of agriculture.

In conclusion, it seems necessary to underline an essential aspect of the problems of mechanization in under-developed countries; that of general servicing. It is no use using machines, if no provision is made for maintenance and repair shops, stocks of spare parts, installations for the storage of fuel, etc. This implies, of course, heavy investment but, without these arrangements for servicing, the machines can only have a very short life.

Exchange of Rice Seeds

Recently the Joint Commission on Rural Reconstruction in Taiwan, China, dispatched samples of five Taiwanese rice varieties, 50 grams each, to the Directorate of Agriculture, Djeddah, Saudi Arabia for trial planting upon the request of the International Rice Commission. The following is the list:

Name of variety	Name of Commercial group	Origin	Superior characters
Kwanfu 401	Horai rice	Hybrid of Japonica and Indica Groups of rice	High yield and considerable resistance to rice blast disease
Taichung 65	Horai rice	Hybrid of Japonica Group of rice	High yield and good table quality
Kaoshiung 10	Horai rice	Hybrid of Japonica Group of rice	Best table quality
Taichung glutinous 46	Round glutinous	Hybrid of Japonica and Indica Groups of rice	High yield
I-Kung-Pao	Native rice	Native variety	High yield and high adaptability to non-fertile soil

Printed and Published by Mrs. Prayat Jataputra at Udom Press, 395-401 New Road, Bangkok. 2496